

Serial No. 10/032,478

Attorney Docket No. 259/010 CIP

AMENDMENTS TO CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) An array of resilient solder bonding structures, each one solder bonding structure comprising a solder ball connecting a contact pad on a first surface to a contact pad on a second surface, each solder ball having a continuous curved exterior surface completely enclosing a first volume and having a completely enclosed interior cavity having a displacement constituting a second volume, the solder ball connecting at least one metal contact on a first surface to at least one metal contact on a second surface which, together with the first surface and the contact pad of the first surface and with the second surface and the contact pad of the second surface, defines a total volume of the solder bonding structure and completely encloses an interior cavity defined by an interior surface of the solder bonding structure, the interior cavity having a displacement constituting a second volume, wherein the interior cavity is in direct contact with the interior surface of the solder bonding structure and the second volume is not less than about 1% and not more than about 90% of the total volume of the solder bonding structure.

Serial No. 10/032,478

Attorney Docket No. 259/010 CIP

2. (Currently Amended) The array of resilient solder bonding structures as claimed in claim 1, wherein ~~the second volume is not less than about 1% of the first volume~~ the contact pad on the first surface and the contact pad on the second surface are annular.

3. (Currently Amended) The array of resilient solder bonding structures as claimed in claim 1, wherein ~~the second volume is not more than about 90% of the first volume~~ the contact pad on the first surface is annular and the contact pad on the second surface is circular.

4. (Currently Amended) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching an integrated circuit to a planar substrate, comprising a plurality of solder ball structures, each solder ball structure attaching one of a plurality of conductive contact pads on the integrated circuit to an associated one of a plurality of conductive contact pads on the planar substrate and having a continuous curved exterior surface completely enclosing a first volume and having a completely enclosed interior cavity having a displacement constituting a second volume, each solder ball structure attaching one of a plurality of first metal contacts on the integrated circuit to an associated one of a plurality of second metal contacts on the planar substrate which, together with the integrated circuit and the one of a plurality of conductive contact pads on the integrated circuit and with the planar substrate and the associated one of a plurality of conductive contact pads on the planar substrate, defines a total volume of each solder ball structure and completely encloses an interior cavity defined by an interior surface of the solder ball structure, the interior cavity having a displacement constituting a second volume, wherein the interior cavity is in direct contact with the interior surface of the

Serial No. 10/032,478

Attorney Docket No. 259/010 CIP

solder ball structure and the second volume is not less than about 1% and not more than about 90% of the total volume of the solder ball structure.

5. (Currently Amended) The resilient BGA attachment means as claimed in claim 4 ~~4~~, wherein ~~the second volume is not less than about 1% of the first volume~~ the plurality of conductive contact pads on the integrated circuit and the plurality of conductive contact pads on the planar substrate are annular.

6. (Currently Amended) The resilient BGA attachment means as claimed in claim 4 ~~5~~, wherein ~~the second volume is not more than about 90% of the first volume~~ the plurality of conductive contact pads on the integrated circuit or the plurality of conductive contact pads on the planar substrate are circular.

7. (Currently Amended) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching an integrated circuit to a printed circuit board, comprising a plurality of solder ball structures, each solder ball structure attaching one of a plurality of conductive contact pads on the integrated circuit to an associated one of a plurality of conductive contact pads on the printed circuit board and having a continuous curved exterior surface ~~completely enclosing a first volume and having a completely enclosed interior cavity having a displacement constituting a second volume,~~ each solder ball structure ~~attaching one of a plurality of first metal contacts on the integrated circuit to an associated one of a plurality of second metal contacts on the printed circuit board~~

Serial No. 10/032,478

Attorney Docket No. 259/010 CIP

which, together with the integrated circuit and the one of a plurality of conductive contact pads on the integrated circuit and with the printed circuit board and the one of a plurality of conductive contact pads on the printed circuit board, defines a total volume of each solder ball structure and completely encloses an interior cavity defined by an interior surface of the solder ball structure, the interior cavity having a displacement constituting a second volume, wherein the interior cavity is in direct contact with the interior surface of the solder bonding structure and the second volume is not less than about 1% and not more than about 90% of the total volume of the solder ball structure.

8. (Original) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 7, wherein a substrate of the printed circuit board is made of organic materials.

9. (Original) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 7, wherein a substrate of the printed circuit board is made of inorganic materials.

10. (Currently Amended) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 7, wherein ~~the second volume is not less than about 1% of the first volume~~ the plurality of conductive contact pads on the integrated circuit and the plurality of conductive contact pads on the printed circuit board are annular.

Serial No. 10/032,478

Attorney Docket No. 259/010 CIP

11. (Currently Amended) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 7, wherein ~~the second volume is not more than about 90% of the first volume~~ the plurality of conductive contact pads on the integrated circuit or the plurality of conductive contact pads on the printed circuit board are circular.

12. (Currently Amended) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate, comprising a plurality of solder ball structures, each solder ball structure attaching one of a plurality of conductive contact pads on the first planar substrate to an associated one of a plurality of conductive contact pads on the second planar substrate ~~and having a continuous curved exterior surface completely enclosing a first volume and having a completely enclosed interior cavity having a displacement constituting a second volume, each solder ball structure attaching one of a plurality of first metal contacts on the first planar substrate to an associated one of a plurality of second metal contacts on the second planar substrate~~ which, together with the first planar substrate and the one of a plurality of conductive contact pads on the first planar substrate and with the second planar substrate and the associated one of a plurality of conductive contact pads on the second planar substrate, defines a total volume of each solder ball structure and completely encloses an interior cavity defined by an inner surface of the solder ball structure, the interior cavity having a displacement constituting a second volume, wherein

Serial No. 10/032,478Attorney Docket No. 259/010 CIP

the interior cavity is in direct contact with the interior surface of the solder ball structure
and the second volume is not less than 1% and not more than 90% of the total volume of
the solder ball structure.

13. (Original) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 12, wherein the first and second planar substrates are first and second printed circuit boards, respectively.

14. (Original) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 13, wherein the first and second printed circuit boards are made of organic materials.

15. (Original) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 13, wherein the first and second printed circuit boards are made of inorganic materials.

16. (Currently Amended) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 12, wherein ~~the second volume is not less than about 1% of the first volume~~ the plurality of conductive contact pads on the first planar substrate and the plurality of conductive contact pads on second planar substrate are annular.

Serial No. 10/032,478

Attorney Docket No. 259/010 CIP

17. (Currently Amended) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 12, wherein ~~the second volume is not more than about 90% of the first volume~~ the plurality of conductive contact pads on the first planar substrate or the plurality of conductive contact pads on the second planar substrate are circular.

18. (Currently Amended) The resilient ball grid array (BGA) electrical and mechanical attachment means as claimed in claim 12, wherein the first and second planar substrates are comprised of one or more materials selected from the group consisting of plastic, ceramic, and epoxy-glass.

19. (New) An array of resilient solder bonding structures, each solder bonding structure comprising a solder ball connecting a conductive contact pad on a first surface to a conductive contact pad on a second surface, each solder ball having an exterior wall having a first end and a second end, the first end being connected to the conductive contact pad on the first surface and the second end being connected to the conductive contact pad on the second surface; and

a cavity enclosed by the exterior wall of the solder ball.

20. (New) An array of resilient solder bonding structures as claimed in claim 19, wherein the cavity communicates with an inner hole of the first conductive contact pad on the first surface.

Serial No. 10/032,478Attorney Docket No. 259/010 CIP

21. (New) An array of resilient solder bonding structures as claimed in claim 20, wherein the cavity communicates with an inner hole of the second conductive contact pad on the second surface.

22. (New) An array of resilient solder bonding structures as claimed in claim 19, wherein the solder ball is a cylindrical solder structure.

23. (New) An array of resilient solder bonding structures as claimed in claim 22, wherein the cylindrical solder structure has a barrel-shaped exterior.

24. (New) An array of resilient solder bonding structures as claimed in claim 19, wherein the exterior wall of the solder structure is flexible.

25. (New) An array of resilient solder bonding structures as claimed in claim 19, wherein a volume of the cavity of the cylindrical solder structure is not less than 1% and not more than 90% of an entire volume of the cylindrical solder structure.

26. (New) An array of resilient solder bonding structures as claimed in claim 19, wherein a material of the solder structure comprises a solder fluxing agent and a mixture of one or more selected from the group consisting of solder, silver, and tin.

Serial No. 10/032,478Attorney Docket No. 259/010 CIP

27. (New) An array of resilient solder bonding structures as claimed in claim 26, wherein the solder fluxing agent comprises more than one selected from the group consisting of rosin, resin, activator, thixotropic agent and a high temperature boiling solvent.

28. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate, comprising a plurality of solder ball structures, each solder ball structure attaching one of a plurality of conductive contact pads on the first planar substrate to an associated one of a plurality of conductive contact pads on the second planar substrate, each solder ball having an exterior wall having a first end and a second end, the first end being connected to the one of a plurality of conductive contact pads on the first planar substrate and the second end being connected to the associated one of a plurality of conductive contact pads on the second planar substrate; and

a cavity enclosed by the exterior wall of the solder ball.

29. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in claim 28, wherein the cavity communicates with an inner hole of the first annular conductive pad.

30. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in

Serial No. 10/032,478Attorney Docket No. 259/010 CIP

claim 29, wherein the cavity communicates with an inner hole of the second annular conductive pad.

31. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in claim 28, wherein the solder structure is a cylindrical solder structure.

32. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in claim 31, wherein the cylindrical solder structure has a barrel-shaped exterior.

33. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in claim 28, wherein the exterior wall of the solder structure is flexible.

34. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in claim 28, wherein a volume of the cavity of the cylindrical solder structure is not less than 1% and not more than 90% of an entire volume of the cylindrical solder structure.

35. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in

Serial No. 10/032,478Attorney Docket No. 259/010 CIP

claim 28, wherein a material of the solder structure comprises a solder fluxing agent and a mixture of one or more selected from the group consisting of solder, silver, and tin.

36. (New) A resilient ball grid array (BGA) electrical and mechanical attachment means for attaching a first planar substrate to a second planar substrate as claimed in claim 35, wherein the solder fluxing agent comprises more than one selected from the group consisting of rosin, resin, activator, thixotropic agent and a high temperature boiling solvent.